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THE EFFECT OF SELECTED AGRICULTURAL FACTORS ON THE YIELDING OF SPAGHETTI SQUASH (*Cucurbita pepo* L.)

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Abstract. Spaghetti squash is an interesting novelty in Poland. Popularization of spaghetti squash cultivation in our country requires development of agricultural recommendations. The size and the quality of yield is highly affected by the sowing date and plant population. The paper presents the results of a four-year study on the effect of the sowing date (5, 15 and 25 May) and plant spacing (1 × 0.6 m, 1 × 0.8 m and 1 × 1 m, ie. 16,668, 12,500 and 10,000 plants per ha) on the yield of spaghetti squash ('Makaronowa Warszawska' and 'Pyza') under the soil and climatic conditions of central-eastern Poland. The highest yield per hectare and the largest number of marketable fruits per plant was obtained while sowing on 5 May. Delaying the sowing date resulted in a decrease in the yield per hectare and of the number of marketable fruits per plant, although the average weight of a marketable fruit sown on 15 and 25 May did not significantly differ in comparison to sowing on 5 May. Increasing the spacings between plants from 1 × 0.6 m to 1 × 1 m resulted in decreasing the yield per hectare, but the number of marketable fruits per plant was larger. Plant spacing did not have a significant effect on the average weight of a marketable fruit. The yield per hectare for the 'Pyza' was larger in comparison to the 'Makaronowa Warszawska'. The number of marketable fruits per plant did not significantly differ, but the weight of the 'Pyza' fruit was higher.

Key words: spaghetti squash, sowing date, plant spacing, yield

INTRODUCTION

Cucurbita pepo L. is characterized by a large variety of fruit shapes, sizes and colours. This species includes forms with edible fruits, known as pumpkins and a squash, as well as decorative forms, known as gourds. Much of the variability of fruit characteristics among the cultivated *Cucurbita pepo* L. provides the possibility of culinary use of mature fruit and seeds, as well as young fruits. *Cucurbita pepo* L. is recognized as one of the most economically important vegetable crops in the world and is grown in almost

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all temperate and subtropical regions [Paris 1996, Nath 2007]. Plants cultivated in Poland include summer squash and zucchini, while spaghetti squash is little-known. This vegetable novelity should be popularized in Poland due to its nutritional value, gustatory and dietetic values, and also easy cultivation and possibility of organic cultivation [Danilczenko et al. 2003]. Popularization of spaghetti squash cultivation requires development of agricultural recommendations adjusted to specific soil and climatic conditions. There is little information concerning spaghetti squash cultivation in Poland [Biesiada et al. 2006, Rolbiecki et al. 2006]. As regards agricultural factors, the size and the yield quality of cultivated plants is highly affected by the choice of optimal sowing date and plant spacing. Johannsonn and Stephenson [1998] found that high temperatures delayed formation of female flowers of *Cucurbita pepo* L. and reduced the number of pollen grains. Extending the fructification period to the warmest months can result in yield reduction by up to 74%. Research conducted in Florida, Argentina and Israel has shown that a higher plant population of spaghetti squash results in the increase of yield per area unit, but the fruit are generally smaller due to more plant-plant competition for water, nutrients and light [Hamner and Stoffella 1996, Beany et al. 1998, Castagnino et al. 2005, 2008, Nerson 2005].

The aim of the study was to determine the effect of the sowing date and plant spacing on the yield of spaghetti squash under the soil and climatic condition of central-eastern Poland.

MATERIALS AND METHODS

The effect of the sowing date (5, 15 and 25 May) and plant spacing (1 × 0.6 m, 1 × 0.8 m and 1 × 1 m, ie. 16,668, 12,500 and 10,000 plants per ha) on spaghetti squash yielding (‘Makaronowa Warszawska’ and ‘Pyza’) was investigated. The ‘Makaronowa Warszawska’ features a bush plant habit with medium-sized, oblong, green spotted fruit with an light orange flesh. The ‘Pyza’ features a bush plant habit with medium-sized, elliptical, orange fruit with an cream-coloured flesh.

The study was carried out in 2006–2009 at the Department of Vegetable Crops, Universtity of Podlasie in Siedlce. A field experiment was established in the split-block-split-plot design in three replications, on a loamy sand soil characterised by mean to high content of available phosphorus, low to mean content of potassium and mean content of magnesium, and pH in H_2O 6.1–6.7. The area of each plot was 20 m^2. Manure in a dose of 30 t ha^{-1} was applied in autumn, and mineral fertilizers in doses of 120 kg N (ammonium nitrate), 52 kg P (superphosphate) and 200 kg K (potassium sulphate) per hectare in spring. 2/3 of the nitrogen and potassium dose was applied before sowing and 1/3 while the first fruits were setting. During the plant vegetation period, weeding and soil loosening were carried out, particularly in the initial period of plant growth, until the leaves covered the soil. Fruits were harvested in the fully mature in September. The total yield of fruit and marketable yield (mature fruits exceeding 0.500 kg, without any damage to the skin) per hectare was determined, as well as the number of marketable fruits per plant and the average weight of a marketable fruit. The results of the experi-

ment were analysed statistically by means of analysis of variance. The significance of differences was verified using the Tukey's test at $\alpha = 0.05$.

Table 1. Mean air temperature and precipitation sums in the vegetation period of vegetable spaghetti

Tabela 1. Średnia temperatura powietrza i suma opadów atmosferycznych w okresie wegetacji dyni makaronowej

Months Miesiące	Temperature – Temperatura, °C					Rainfalls – Opady, mm				
	2006	2007	2008	2009	mean średnio 1981–2005	2006	2007	2008	2009	mean średnio 1981–2005
May – Maj	13.6	14.6	12.7	12.9	11.9	39.6	59.1	85.6	68.9	49.7
June – Czerwiec	17.2	18.2	17.4	15.7	16.7	24.0	59.0	49.0	145.2	63.0
July – Lipiec	22.3	18.9	18.4	19.4	19.5	16.2	70.2	69.8	26.4	60.3
August – Sierpień	18.0	18.9	18.5	17.7	18.4	227.6	31.1	75.4	80.9	59.8
September – Wrzesień	15,4	13.1	12.2	14.6	13.1	64.4	67.6	63.3	24.9	53.0

The favourable thermal and moisture conditions for spaghetti squash cultivation were only in 2007 (tab. 1). In 2006, the growth and development of plants was limited by drought in June and July, while in 2008 and 2009, low air temperatures and intensive rainfall in May resulted in poor emergence.

RESULTS AND DISCUSSION

Weather conditions in subsequent years of study had a significant effect on the yield of spaghetti squash (tabs. 2–5). The highest total yield of fruit and marketable yield, on average 55.71 t ha^{-1} and 53.52 t ha^{-1}, respectively, was obtained in the warmest and moderately moisture growing season of 2007. The number of marketable fruits per plant and the average weight of a marketable fruit was the highest in 2008, the year of the most even distribution of precipitation during the vegetation period of plants. In that year, 5.3 marketable fruits were obtained, on average, per plant, and the average fruit weight was 1.589 kg.

The sowing date had a significant effect on the yield of spaghetti squash. The highest total yield of fruits and of marketable fruits was obtained when seeds were sown on 5 May, in the four-year period of study, on average, 50.04 t ha^{-1} and 48.70 t ha^{-1}, respectively (tab. 2 and 3). Delaying the sowing date resulted in a decrease of the yield. The yield obtained with sowing dates on 5 and 15 May did not significantly differ, but with the sowing date on 25 May, the total yield of fruit was on average lower by 5.29 t ha^{-1} (12%), and the marketable yield – by 5.57 t ha^{-1} (13%). The highest differences in yielding were observed in 2006 and 2009. A quite low air temperature and intensive rainfall in the third decade of May and at the beginning of July resulted in very poor emergence and in effect, the yield of seeds sown on 5 May in 2006 was over 1.5 times higher, while in 2009 it was almost twofold in comparison to sowing on 25 May. Only in 2008,

the year of the lowest air temperature and very intensive rainfall in the first decade of May, was the yield with a sowing date on 25 May over 1.5 times higher than with earlier sowing dates.

Table 2. Total yield of fruit, t ha^{-1}
Tabela 2. Plon owoców ogółem, t·ha^{-1}

Years Lata	Sowing date Termin siewu	Plant spacing – Rozstawa roślin			Cultivar – Odmiana		Mean Średnio
		1 × 0.6 m	1 × 0.8 m	1 × 1 m	Makaronowa Warszawska	Pyza	
2006	5 May – maj	50.89	47.06	49.87	48.80	49.75	49.27
	15 May – maj	39.80	33.98	38.30	42.64	32.08	37.36
	25 May – maj	33.52	31.87	28.98	33.06	29.85	31.46
	mean – średnio	41.40	37.64	39.05	41.50	37.23	39.36
2007	5 May – maj	57.80	53.68	50.04	45.46	62.21	53.84
	15 May – maj	57.93	56.50	55.62	52.11	61.26	56.68
	25 May – maj	58.19	55.00	56.65	52.66	60.56	56.61
	mean – średnio	57.97	55.06	54.10	50.08	61.34	55.71
2008	5 May – maj	44.59	38.13	30.21	46.78	28.60	37.64
	15 May – maj	50.58	38.58	24.50	36.59	39.18	37.89
	25 May – maj	60.95	59.51	58.57	53.70	65.65	59.68
	mean – średnio	52.04	45.40	37.76	45.69	44.48	45.07
2009	5 May – maj	58.74	61.52	57.97	40.97	77.84	59.41
	15 May – maj	58.68	61.31	53.11	42.66	72.74	57.70
	25 May – maj	27.79	30.30	35.74	22.40	40.15	31.28
	mean – średnio	48.40	51.04	48.94	35.34	63.58	49.46
Mean Średnia	5 May – maj	53.00	50.10	47,02	45.50	54.58	50.04
	15 May – maj	51.75	47.59	42.88	43.50	51.32	47.41
	25 May – maj	45.11	44.17	44.98	40.46	49.05	44.75
Mean – Średnio		49.96	47.28	44.96	43.15	51.65	47.40

LSD – NIR $_{0.05}$: years – lata = 5.45, sowing date – termin siewu = 4.26, years × sowing date – lata × termin siewu = 8.51, plant spacing – rozstawa roślin = 2.24, years × plant spacing – lata × rozstawa roślin = 4.48, sowing date × plant spacing – termin siewu × rozstawa roślin = 4.31, yeras × sowing date × plant spacing – lata × termin siewu × rozstawa roślin = 8.62, cultivar – odmiana = 7.81

The study showed the significant effect of the sowing date on the number of marketable fruits per plant and on the average weight of marketable fruit (tab. 4 and 5). The greatest number of marketable fruits per plant, 4.8 fruits on average, was obtained with a sowing date on 5 May. The average fruit weight was 1.380 kg. The number of marketable fruits per plant was reduced when the sowing date was delayed, but the average weight of a marketable fruit sown on 15 and 25 May did not significantly differ in comparison to sowing on 5 May. The sowing date had the greatest effect on the number of marketable fruits per plant and the average fruit weight in 2008 (the year of the lowest mean air temperature and quite heavy rainfall in the second half of August and in September, during the fruit ripening period). In that year, with the sowing date on 25 May, the number of marketable fruits per plant was lower, by 2.6 on average and the fruit weight – by 0.217 kg (14%) in comparison to sowing on 5 May. In the study carried out by Castagnino et al. [2008] in Argentina, the average weight of the fruit with a sowing date on 24 November was, on average, by 0.360 kg (29%) higher in comparison to sowing on 10 November.

The studies carried out in Florida, Argentina and Israel showed that an increase in the number of plants in one area unit resulted in increasing the yield of spaghetti squash, but the number of marketable fruits per plant and the average fruit weight were lower [Hamner and Stoffella 1996, Castagnino et al. 2005, 2008, Nerson 2005], which was confirmed by the present study. The total yield of fruits with plant spacing of 1 × 0.6 m (16,668 plants per ha) was higher on average by 2.68 t ha^{-1} (6%), and the marketable yield – by 2.10 t ha^{-1} (4%) than in the case of plant spacing of 1 × 0.8 m (12,500 plants per ha), while in comparison to plant spacing of 1 × 1 m (10,000 plants per ha), the yield was higher by 5.00 t ha^{-1} (11%) and 4.67 t ha^{-1} (11%), respectively (tabs. 2 and 3). Plant spacing had the greatest effect on the yield of spaghetti squash in 2008, the year of the most even distribution of precipitation in the plant vegetation period. In that year, the yield of total fruit with a plant spacing of 1 × 0.6 m was on average higher by even 14.26 t ha^{-1} (38%), and marketable yield by 14.14 t ha^{-1} (39%) in comparison to 1 × 1 m spacing. Plant spacing had the greatest effect on spaghetti squash yielding with sowing date on 5 and 15 May than with a sowing date on 25 May, particularly in 2008. The study conducted in Argentina did not show any significant effect of the interaction between the sowing date and plant spacing on the yield of spaghetti squash [Castagnino et al. 2008].

Table 3. Marketable yield of fruit, t ha^{-1}
Tabela 3. Plon owoców handlowych, t·ha^{-1}

Years Lata	Sowing date Termin siewu	Plant spacing – Rozstawa roślin			Cultivar – Odmiana		Mean Średnio
		1 × 0.6 m	1 × 0.8 m	1 × 1 m	Makaronowa Warszawska	Pyza	
2006	5 May – maj	48.21	44.79	48.38	45.89	48.36	47.13
	15 May – maj	37.89	32.82	36.98	40.74	31.05	35.90
	25 May – maj	32.85	31.42	28.51	32.20	29.66	30.93
	mean – średnio	39.65	36.34	37.95	39.61	36.36	37.98
2007	5 May – maj	56.13	53.13	48.68	43.14	62.15	52.65
	15 May – maj	56.14	54.63	53.25	49.12	60.23	54.67
	25 May – maj	53.27	53.06	53.44	49.08	57.43	53.26
	mean – średnio	55.18	53.61	51.79	47.11	59.94	53.52
2008	5 May – maj	43.82	37.25	29.90	45.82	28.16	36.99
	15 May – maj	49.52	37.80	22.77	35.33	38.06	36.70
	25 May – maj	58.58	58.16	56.85	51.60	64.13	57.86
	mean – średnio	50.64	44.40	36.50	44.25	43.45	43.85
2009	5 May – maj	56.86	60.27	56.95	39.90	76.15	58.03
	15 May – maj	57.59	59.92	51.97	41.97	71.02	56.49
	25 May – maj	27.28	29.73	34.42	22.06	38.89	30.48
	mean – średnio	47.24	49.97	47.78	34.64	62.02	48.33
Mean Średnia	5 May – maj	51.26	48.86	45.98	43.69	53.70	48.70
	15 May – maj	50.29	46.29	41.24	41.79	50,09	45.94
	25 May – maj	43.00	43.09	43.30	38.73	47.53	43.13
Mean – Średnio		48.18	46.08	43.51	41.40	50.44	45.92

LSD – NIR $_{0.05}$: years – lata = 5.21, sowing date – termin siewu = 4.07, years × sowing date – lata × termin siewu = 8.14, plant spacing – rozstawa roślin = 2.46, years × plant spacing – lata × rozstawa roślin = 4.92, sowing date × plant spacing – termin siewu × rozstawa roślin = 3.79, yeras × sowing date × plant spacing – lata × termin siewu × rozstawa roślin = 7.39, cultivar – odmiana = 7.47

Plant spacing had a significant effect on the number of marketable fruits per plant. The lowest number of marketable fruits per plant was obtained with a plant spacing of 1 × 0.6 m 3.9 fruits, on average (tab. 4). The increase in the distance between plants in a row resulted in increasing the number of marketable fruits per plant. With a plant spacing of 1 × 1 m, the number of marketable fruits per plant was on average larger by 1.2 in comparison to 1 × 0.6 m spacing. Plant spacing had a greater influence on the number of marketable fruits per plant with sowing dates on 15 and 25 May than with a sowing date on 5 May.

Edelstein et al. [1983] reported that the optimum plant spacing for obtaining the largest number of fruits and yield of spaghetti squash in Israel was 20,000 plants per hectare. The study of Castagnino et al. [2005] conducted in Argentina showed that the optimum plant density for spaghetti squash cultivation was 10,000 or 15,000 plants per hectare. This number of plants per hectare resulted in obtaining the greatest number of fruits of average size (1–1.5 kg), which are most appropriate for the market. The presented study did not find any significant effect of plant spacing on the average weight of marketable fruit, but the trend of the increase in average weight of marketable fruit with an increase in the distance between plants in a row was observed (tab. 5). Only with a sowing date on 5 May, did an increase in the distance between plants in one row from 0.6 m to 1 m result in a significant increase in the average weight of marketable fruit, by 0.127 kg (10%).

Table 4. Number of marketable fruit per plant, pcs
Tabela 4. Liczba owoców handlowych z jednej rośliny, szt.

Years Lata	Sowing date Termin siewu	Plant spacing – Rozstawa roślin			Cultivar – Odmiana		Mean Średnio
		1 × 0.6 m	1 × 0.8 m	1 × 1 m	Makaronowa Warszawska	Pyza	
2006	5 May – maj	4.0	4.8	4.2	4.9	3.8	4.3
	15 May – maj	3.4	3.7	3.8	4.2	3.1	3.6
	25 May – maj	4.1	3.7	5.8	4.8	4.3	4.5
	mean – średnio	3.8	4.1	4.6	4.6	3.7	4.2
2007	5 May – maj	2.7	3.3	3.5	3.5	2.8	3.2
	15 May – maj	2.6	3.3	4.2	3.6	3.1	3.4
	25 May – maj	2.7	3.5	4.3	3.8	3.3	3.5
	mean – średnio	2.7	3.4	4.0	3.6	3.1	3.3
2008	5 May – maj	6.2	6.5	5.9	5.5	6.9	6.2
	15 May – maj	5.0	5.9	7.3	5.2	6.9	6.1
	25 May – maj	2.8	3.6	4.4	3.6	3.5	3.6
	mean – średnio	4.6	5.3	5.9	4.8	5.8	5.3
2009	5 May – maj	4.3	6.3	6.6	6.1	5.3	5.7
	15 May – maj	4.4	5.4	4.9	5.2	4.5	4.9
	25 May – maj	4.8	5.5	5.9	5.7	5.1	5.4
	mean – średnio	4.5	5.7	5.8	5.7	5.0	5.3
Mean Średnia	5 May – maj	4.3	5.2	5.1	5.0	4.7	4.8
	15 May – maj	3.8	4.6	5.1	4.5	4.4	4.5
	25 May – maj	3.6	4.1	5.1	4.5	4.0	4.3
Mean – Średnio		3.9	4.6	5.1	4.7	4.4	4.5

LSD – NIR $_{0.05}$: years – lata = 0.6, sowing date – termin siewu = 0.4, years × sowing date – lata × termin siewu = 0.9, plant spacing – rozstawa roślin = 0.4, sowing date × plant spacing – termin siewu × rozstawa roślin = 0.5, yeras × sowing date × plant spacing – lata × termin siewu × rozstawa roślin = 1.1, cultivar – odmiana = n.s. – r. n.

Table 5. Average weight of marketable fruit, kg
Tabela 5. Średnia masa owocu handlowego, kg

Years Lata	Sowing date Termin siewu	Plant spacing – Rozstawa roślin			Cultivar – Odmiana		Mean Średnio
		1 × 0.6 m	1 × 0.8 m	1 × 1 m	Makaronowa Warszawska	Pyza	
2006	5 May – maj	1.072	1.130	1.270	0.932	1.384	1.160
	15 May – maj	1.086	1.090	1.180	1.032	1.206	1.120
	25 May – maj	1.285	1.449	1.389	1.129	1.620	1.374
	mean – średnio	1.148	1.226	1.278	1.031	1.403	1.217
2007	5 May – maj	1.396	1.430	1.570	1.143	1.788	1.470
	15 May – maj	1.381	1.410	1.370	1.146	1.630	1.390
	25 May – maj	1.324	1.340	1.288	1.136	1.498	1.317
	mean – średnio	1.367	1.393	1.410	1.142	1.639	1.390
2008	5 May – maj	1.571	1.700	1.870	1.406	2.017	1.710
	15 May – maj	1.528	1.520	1.640	1.332	1.794	1.560
	25 May – maj	1.481	1.552	1.445	1.230	1.755	1.493
	mean – średnio	1.527	1.589	1.651	1.323	1.855	1.589
2009	5 May – maj	1.066	1.230	1.180	0.987	1.333	1.160
	15 May – maj	1.351	1.320	1.240	1.080	1.526	1.300
	25 May – maj	1.612	1.456	1.561	1.362	1.724	1.543
	mean – średnio	1.343	1.335	1.328	1.143	1.528	1.335
Mean Średnia	5 May – maj	1.298	1.370	1.470	1.131	1.631	1.380
	15 May – maj	1.336	1.340	1.360	1.148	1.539	1.340
	25 May – maj	1.425	1.449	1.421	1.214	1.649	1.432
Mean – Średnio		1.353	1.386	1.417	1.164	1.606	1.385

LSD – NIR $_{0.05}$: years – lata = 0.104, sowing date – termin siewu = 0.082, years × sowing date – lata × termin siewu = 0.163, plant spacing – rozstawa roślin = n.s. – r.n., sowing date × plant spacing – termin siewu × rozstawa roślin = 0.096, cultivar – odmiana = 0.216

The yield of spaghetti squash fruit per hectare, as well as the number of marketable fruits per plant and the average weight of a marketable fruit, depends on the cultivar. Plants of spaghetti squash of bush habit produce lower vegetation mass than plants of vine habit, but they produce more fruits and give higher yield [Edelstein et al. 1989, Beany et al. 1998, 2002, Castagnino et al. 2005]. In the presented study, the total yield of fruits of the 'Pyza'was on average higher by 8.50 t ha^{-1} (20%), and marketable yield was higher by 9.04 t ha^{-1} (22%) than the 'Makaronowa Warszawska'. The number of marketable fruits per plant of the examined cultivars of spaghetti squash did not significantly differ, but the weight of fruit of the 'Pyza' was on average higher by 0.442 kg (38%) (tabs. 2–5). A similar yield of spaghetti squash was obtained in the area of Bydgoszcz, on very light soil. The marketable yield of the 'Pyza', with a sowing date in the third decade of May and plant spacing of 1 × 0.65 m, was higher on average by 12.50 t ha^{-1} (35%) in cultivation without irrigation, and by 16.10 t ha^{-1} (31%) in cultivation with drip irrigation, as compared to the 'Makaronowa Warszawska'. Irrigation resulted in a higher yield increase of the 'Makaronowa Warszawska'. The number of fruits per plant and the average fruit weight of the 'Pyza' was higher than the 'Makaronowa Warszawska' [Rolbiecki et al. 2006]. In the Wrocław region, the marketable yield of the 'Pyza' (with sowing date in the second week of May and plant spacing of 1 × 1 m) amounted to only 5.84 t ha^{-1}. On average, 3.9 fruits were obtained from one

plant with a weight of 1.500 kg [Biesiada et al. 2006]. In the presented study, the marketable yield of the 'Pyza', with a sowing date on 15 May and plant spacing of 1 × 1 m, was almost 8 times higher. An average of 5.2 fruits were obtained per plant, of a weight of 1.541 kg (tab. 4 and 5).

CONCLUSIONS

1. The highest yield of fruit per hectare was obtained in 2007, the year of the highest air temperature in May and June, favouring quick and even emergence, while the number of marketable fruits per plant and a average weight of the marketable fruit was the highest in 2008, the year of the most even distribution of precipitation in the period of plant vegetation.

2. The highest yield per hectare and the largest number of marketable fruits per plant was obtained with a sowing date of 5 May. Delaying the sowing date resulted in a decrease in the yield per hectare and in the number of marketable fruits per plant, although the average weight of marketable fruit sown on 15 and 25 May did not significantly differ in comparison to sowing on 5 May.

3. Increasing the spacing between plants from 1 × 0.6 m to 1 × 1 m resulted in lowering the yield per hectare, but the number of marketable fruit per plant was larger. Plan spacing did not have a significant effect on the average weight of a marketable fruit.

4. The yield per hectare for the 'Pyza' was higher in comparison to the 'Makaronowa Warszawska'. The number of marketable fruits per plant did not significantly differ, but the weight of the 'Pyza' fruit was higher.

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WPŁYW WYBRANYCH CZYNNIKÓW AGROTECHNICZNYCH NA PLONOWANIE DYNI MAKARONOWEJ (*Cucurbita pepo* L.)

Streszczenie. Dynia makaronowa jest interesującą nowością w Polsce. Rozpowszechnienie uprawy dyni makaronowej w naszym kraju wymaga opracowania zaleceń agrotechnicznych. Duży wpływ na wielkość i jakość plonu ma termin siewu i obsada roślin. W 4-letnich badaniach określano wpływ terminu siewu (5, 15 i 25 maja) i rozstawy roślin (1 × 0,6 m, 1 × 0,8 m i 1 × 1 m, tj. 16 668, 12 500 i 10 000 roślin na 1 ha) na plonowanie dyni makaronowej ('Makaronowa Warszawska' i 'Pyza') w warunkach glebowo-klimatycznych środkowowschodniej Polski. Największy plon z 1 ha i największą liczbę owoców handlowych z jednej rośliny uzyskano przy siewie 5 maja. Opóźnienie terminu siewu powodowało zmniejszenie plonu z 1 ha i liczby owoców handlowych z jednej rośliny, ale średnia masa owocu handlowego przy siewie 15 i 25 maja nie różniła się istotnie w porównaniu z siewem 5 maja. Zwiększenie rozstawy roślin z 1 × 0,6 m do 1 × 1 m powodowało zmniejszenie plonu z 1 ha, ale liczba owoców handlowych z jednej rośliny była większa. Rozstawa roślin nie miała istotnego wpływu na średnią masę owocu handlowego. Plon z 1 ha odmiany 'Pyza' był większy niż odmiany 'Makaronowa Warszawska'. Liczba owoców handlowych z jednej rośliny nie różniła się istotnie, ale masa owoców odmiany 'Pyza' była większa.

Słowa kluczowe: dynia makaronowa, termin siewu, gęstość siewu, plon

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